

422 459

FLOOD INSURANCE STUDY

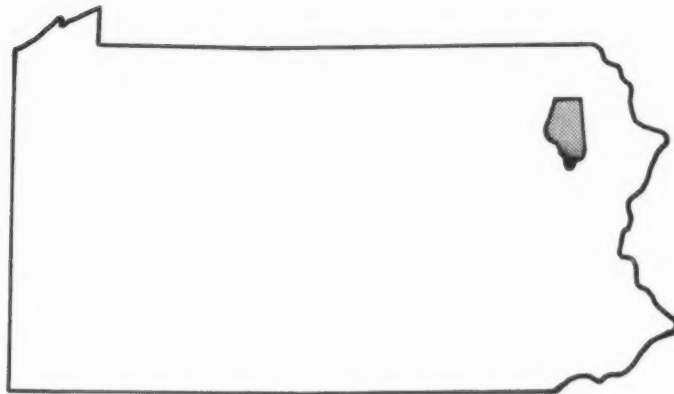


NEWARK PUBLIC LIBRARY

APR 14 1981

U. S. GOVT. PUBS.
DEPOSITORY 376

TOWNSHIP OF
LEHIGH,
PENNSYLVANIA
LACKAWANNA COUNTY



DECEMBER 15, 1980



federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 422459

FEM 1.209:

TABLE OF CONTENTS

	<u>Page</u>
1.0 <u>INTRODUCTION</u>	1
1.1 Purpose of Study	1
1.2 Authority and Acknowledgements	1
1.3 Coordination	1
2.0 <u>AREA STUDIED</u>	2
2.1 Scope of Study	2
2.2 Community Description	2
2.3 Principal Flood Problems	4
2.4 Flood Protection Measures	4
3.0 <u>ENGINEERING METHODS</u>	4
3.1 Hydrologic Analyses	5
3.2 Hydraulic Analyses	6
4.0 <u>FLOOD PLAIN MANAGEMENT APPLICATIONS</u>	7
4.1 Flood Boundaries	7
4.2 Floodways	8
5.0 <u>INSURANCE APPLICATION</u>	10
5.1 Reach Determinations	10
5.2 Flood Hazard Factors	11
5.3 Flood Insurance Zones	11
5.4 Flood Insurance Rate Map Description	13

TABLE OF CONTENTS - continued

	<u>Page</u>
6.0 <u>OTHER STUDIES</u>	13
7.0 <u>LOCATION OF DATA</u>	14
8.0 <u>BIBLIOGRAPHY AND REFERENCES</u>	14

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Floodway Schematic	10

TABLES

Table 1 - Summary of Discharges	5-6
Table 2 - Floodway Data	9
Table 3 - Flood Insurance Zone Data	12

EXHIBITS

Exhibit 1 - Flood Profiles Lehigh River	Panels 01P-02P
--	----------------

Exhibit 2 - Flood Boundary and Floodway Map Index

Exhibit 3 - Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index

Flood Insurance Rate Map

FLOOD INSURANCE STUDY
TOWNSHIP OF LEHIGH, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Lehigh, Lackawanna County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Lehigh to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Betz, Converse, Murdoch, Inc., for the Federal Insurance Administration, under Contract No. H-4815. This work was completed in December 1979.

1.3 Coordination

On May 17, 1978, streams requiring detailed study were identified at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of the FIA, the Township of Lehigh, and Betz, Converse, Murdoch, Inc. (the study contractor). During the course of the study, several contacts were made with township officials to obtain pertinent information. On April 23, 1980, a final CCO meeting was held with representatives of the FIA, the township, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Lehigh, Lackawanna County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1). The Lackawanna State Forest and State Game Lands No. 135 were not studied.

The Lehigh River was studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through December 1984.

Choke Creek, Pond Creek, Sand Spring Creek, Bear Lake, and Buckey Run were studied by approximate methods. Approximate methods of analysis were used to study those areas having low development potential and minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by the FIA. The flooding at the downstream portions of Pond Creek and Spruce Run is controlled by backwater from the Lehigh River. Flood boundaries are shown on the map but no detailed study was carried out on these streams.

2.2 Community Description

The Township of Lehigh is located at the southern tip of Lackawanna County in northeastern Pennsylvania. It is approximately 12 miles south of the City of Scranton. The township is bordered by the Township of Spring Brook to the north, the Townships of Plains, Bear Creek and Buck to the west, the Township of Buck to the southwest, the Townships of Tobyhanna and Coolbaugh to the southeast, and the Township of Clifton to the northeast.

The total land area contained in Lehigh is approximately 22.8 square miles. According to the U. S. Bureau of the Census, the population increased from 167 in 1970 to 187 in 1975 (References 1 and 2).

The area is rural with more than 75 percent of the land designated as Lackawanna State Forest. Two paved roads traverse the township. Legislative Route 45039 generally parallels the Lehigh River, while Township Route 665 starts at its intersection with Legislative Route 45039 and continues to the western corporate limits of Lehigh just north of Bear Lake.

Lehigh's topography consists of rolling hills, with the highest elevation 2,200 feet and the lowest point almost 800 feet lower. The average slope is about 10 percent. More than 90 percent of the area is woodland.

The climate of Lehigh is humid continental. Summer and winter average temperatures range from 66.8 degrees Fahrenheit (°F) to 24.7°F, respectively. The annual average precipitation of the region is 37 inches with an annual average recorded snowfall of 39.9 inches. The precipitation is fairly evenly distributed throughout the year (Reference 3).

2.3 Principal Flooding Problems

The past history of flooding on the streams within the township indicates that flooding may occur during any season of the year, but most flooding occurs during February, March, April and May as a result of spring rains and snowmelt. Storms occurring during the late summer months are often associated with tropical storms moving up the Atlantic coastline.

The Lehigh River is in the Delaware River Basin, which has experienced a number of major floods in this century. Flood records of a gage at Stoddartsville (gaging station No. 02040106) show a flow of 31,900 cubic feet per second for the tropical storm of August 18, 1955. The gage is located approximately 4 miles downstream of Thornhurst and has a drainage area of 91.7 square miles. The maximum flood elevation for the August 18, 1955 flood was 16 feet (Reference 4). The analysis of the flows at this gaging station yielded a return period of over 300 years for the 1955 flood.

2.4 Flood Protection Measures

There are no structural or non-structural flood protection measures within Lehigh.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals

or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail in the community.

For the Lehigh River at Stoddartsville, existing discharge values as developed by the U. S. Geological Survey (USGS) for the Delaware River Basin Commission were reviewed and updated for use in this study. The values developed by the USGS are based on a statistical analysis of discharge records covering a 33-year period, 1942-1975, at the Stoddartsville gaging station operated by the USGS (Reference 4). The analysis used was the standard log-Pearson Type III method as outlined by the Water Resources Council (Reference 5).

The gage at Stoddartsville, with 91.7 square miles of drainage area, is very close to the area of this study. The drainage area at the confluence of Choke Creek, which is the downstream point of this study, is 82.5 square miles.

The discharge values used in this study update the values of the USGS study by using additional data for a 35-year period of record. The values of the longer record period and the treatment of the 1942 and 1955 storms as historical peaks, as in the USGS study, yielded slightly lower flow values than the USGS study.

A summary of drainage area-peak discharge relationships for the Lehigh River is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

<u>FLOODING SOURCE AND LOCATION</u>	<u>DRAINAGE AREA</u>	<u>PEAK DISCHARGES (cfs)</u>			
	<u>(sq. miles)</u>	<u>10-YEAR</u>	<u>50-YEAR</u>	<u>100-YEAR</u>	<u>500-YEAR</u>
LEHIGH RIVER					
At the confluence of Choke Creek	75.4	6,175	14,070	19,230	39,520

TABLE 1 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>DRAINAGE AREA</u>	<u>PEAK DISCHARGES (cfs)</u>			
	<u>(sq. miles)</u>	<u>10-YEAR</u>	<u>50-YEAR</u>	<u>100-YEAR</u>	<u>500-YEAR</u>
LEHIGH RIVER					
(continued)					
At the confluence of Trout Creek	59.7	5,120	11,780	16,200	31,900
At the confluence of Spruce Run	41.4	3,820	8,960	12,385	24,750

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding source studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along this flooding source.

Cross-section data for the Lehigh River were obtained from a combination of field measurements for below-water contours and photogrammetrically measured above-water contours. Cross sections were selected so that there would not be excessive conveyance changes between them nor more than 10 feet of water-surface elevation difference between them. Selected structures, including all bridges, culverts, and dams, with the potential of controlling flood elevations were field-surveyed to obtain elevation data and hydraulic geometry.

Roughness coefficients (Manning's "n") were estimated by using engineering judgment in examining recent aerial and ground level photographs of the structures, flood plains, and stream channels (Reference 6). The channel roughness value for the Lehigh River was 0.035, and the overbank roughness value was 0.100.

Water-surface elevations for floods of the selected recurrence intervals were developed using the U. S. Army Corps of Engineers (COE) HEC-2 step-backwater computer program (Reference 7). Starting water-surface elevations were determined by the slope/area method.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 3).

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:400 with a contour interval of 5 feet (Reference 6). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

For the streams studied by approximate methods, flood boundaries were taken from the Flood Hazard Boundary Map for Lehigh published by the FIA (Reference 8). The boundaries were reviewed in January 1979 and most were found to be adequate. Where the boundaries were not found to be adequate, they were modified after field investigation.

The review consisted of using the plot of flood depth versus drainage area. The estimated depth and approximate cross sections taken in the field were coordinated with contours on USGS quadrangles to delineate a flood boundary (Reference 9).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within

the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this report is presented to local agencies as a minimum standard that can be adopted or that can be used as a basis for additional studies.

The floodway presented in this study was computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway widths of the Lehigh River extend beyond the corporate limits of the Township of Lehigh.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH ² (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Lehigh River								
A	.09	285/ 57	3,509	5.5	1,513.4	1,513.4	1,514.4	1.0
B	.24	413/340	3,624	4.4	1,514.3	1,514.3	1,515.3	1.0
C	.45	406/312	4,723	3.4	1,515.9	1,515.9	1,516.9	1.0
D	.74	650/252	6,827	2.4	1,517.2	1,517.2	1,518.2	1.0
E	1.15	467/404	3,866	4.0	1,518.6	1,518.6	1,519.5	0.9
F	1.41	122/ 60	1,527	10.0	1,520.4	1,520.4	1,521.4	1.0
G	1.78	100/ 40	1,413	10.8	1,527.3	1,527.3	1,528.0	0.7
H	1.98	70/ 35	798	19.2	1,532.5	1,532.5	1,532.9	0.4
I	2.32	212/120	1,466	10.4	1,543.8	1,543.8	1,544.0	0.2
J	2.59	210/108	1,552	9.9	1,550.1	1,550.1	1,550.1	0.0
K	2.75	212/ 50	2,134	7.2	1,552.3	1,552.3	1,552.9	0.6
L	2.92	206/120	2,352	6.5	1,553.6	1,553.6	1,554.3	0.7
M	3.15	448/130	3,695	3.7	1,555.9	1,555.9	1,556.8	0.9
N	3.44	500/ 40	2,819	4.8	1,557.8	1,557.8	1,558.8	1.0
O	3.75	840/243	6,892	2.0	1,559.8	1,559.8	1,560.7	0.9
P	3.81	680/110	4,751	2.8	1,559.9	1,559.9	1,560.7	0.8
Q	4.25	446/ 70	3,734	3.6	1,562.9	1,562.9	1,563.8	0.9
R	4.52	590/320	3,661	3.4	1,565.1	1,565.1	1,566.1	1.0
S	4.82	450/280	1,650	4.7	1,567.8	1,567.8	1,568.7	0.9
T	4.95	400/ 40	2,547	4.9	1,570.4	1,570.4	1,570.6	0.2

1Miles above confluence of Choke Creek
2width/width within corporate limits

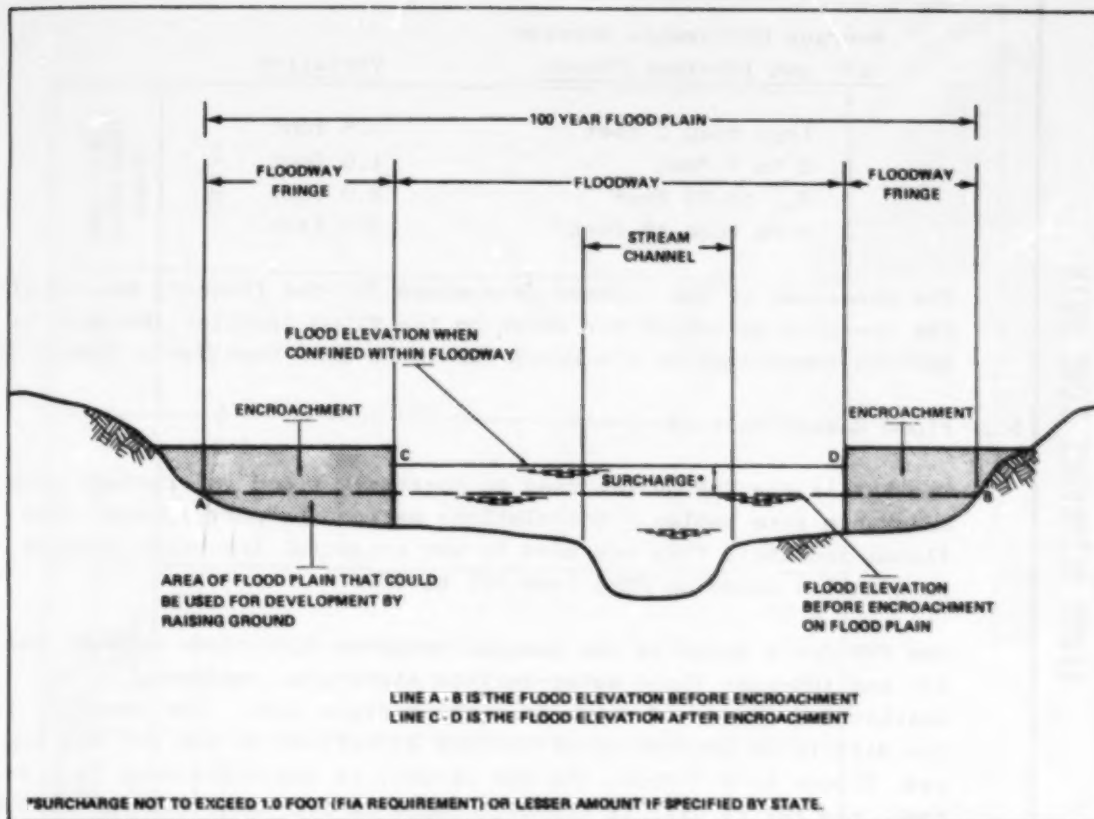
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF LEHIGH, PA
(LACKAWANNA CO.)

FLOODWAY DATA

LEHIGH RIVER

TABLE 2



FLOODWAY SCHEMATIC

Figure 2

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF's), and flood insurance zone designations for the flooding source affecting the Township of Lehigh.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

<u>Average Difference Between 10- and 100-Year Floods</u>	<u>Variation</u>
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding source of the Township of Lehigh are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF's are used to set actuarial insurance premium rate tables based on FHF's from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHF's, the entire incorporated area of the Township of Lehigh was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

- Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHF's determined.
- Zone A10: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.

FLOODING SOURCE	PANEL ¹	ELEVATION DIFFERENCE ² BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION ³ (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Lehigh River Reach 1	06,07,08	-5.2	-1.7	+4.7	050	A10	Varies

¹Flood Insurance Rate Map Panel

²Weighted average

³Rounded to the nearest foot - see map

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF LEHIGH, PA
(LACKAWANNA CO.)

FLOOD INSURANCE ZONE DATA

LEHIGH RIVER

TABLE 3

Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.
Zone D:	Areas of undetermined but possible flood hazard.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHF's, flood insurance zones, and base flood elevations for the flooding source studied in detail in the Township of Lehigh.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Lehigh is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

The Flood Hazard Boundary Map for the Township of Lehigh has been published (Reference 8). The Flood Insurance Study for the Township of Bear Creek has been completed (Reference 10). The results of this study are in exact agreement with the results of that study. No other studies relating to flood problems in Lehigh were found to exist.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Room 700, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of Commerce, Bureau of the Census, 1970 Census of Population, Number of Inhabitants, Pennsylvania, Washington, D. C., U. S. Government Printing Office, 1971.
2. U. S. Department of Commerce, Bureau of the Census, 1975 Population Estimates and 1975 Revised Per Capita Income Estimates for Counties, Incorporated Places, and Selected Minor Civil Divisions, Pennsylvania, Washington, D. C., U. S. Government Printing Office, 1976.
3. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, Monthly Averages of Temperature and Precipitation for Pennsylvania, 1941-1979, Asheville, North Carolina, National Climatic Center, 1979.
4. U. S. Department of the Interior, Geological Survey, Water Data Report, Water Resources Data for Pennsylvania Water Year 1977, IA-77-2, Washington, D. C., 1978.
5. Water Resources Council, "Guidelines for Determining Flood Flow Frequency," Bulletin 17A, Washington, D. C., June 1977.
6. Quinn and Associates, Inc., of Horsham, Pennsylvania, Topographic Maps compiled from aerial photos, Scale 1"=400', Contour Interval 5 Feet, Lehigh River, Township of Lehigh, Lackawanna County, Pennsylvania, November 29, 1978.
7. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis, California, October 1973.
8. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Township of Lehigh, Lackawanna County, Pennsylvania, March 11, 1976.

9. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Thornhurst, Pennsylvania, 1965, Photorevised 1973; Pleasant View Summit, Pennsylvania, 1965, Photorevised 1973; Moscow, Pennsylvania, 1946, Photorevised 1969; Avoca, Pennsylvania, 1946, Photorevised 1969; Sterling, Pennsylvania, 1965, Photorevised 1973; Tobyhanna, Pennsylvania, 1965, Photorevised 1973.
10. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Township of Bear Creek, Luzerne County, Pennsylvania, Washington, D. C., September 29, 1978.

Chow, Ven Te, Open-Channel Hydraulics, New York, McGraw-Hill, 1959.

Commonwealth of Pennsylvania, Department of Environmental Resources, Bulletin No. 9, Hydrologic Data of the June 1972 Flood in Pennsylvania, Harrisburg, Pennsylvania, August 1974.

Commonwealth of Pennsylvania, Department of Environmental Resources, in cooperation with the U. S. Geological Survey, Water Resources Bulletin No. 13, Floods in Pennsylvania, A Manual for Estimation of their Magnitude and Frequency by Herbert J. Flipppo, Jr., Harrisburg, Pennsylvania, October 1977.

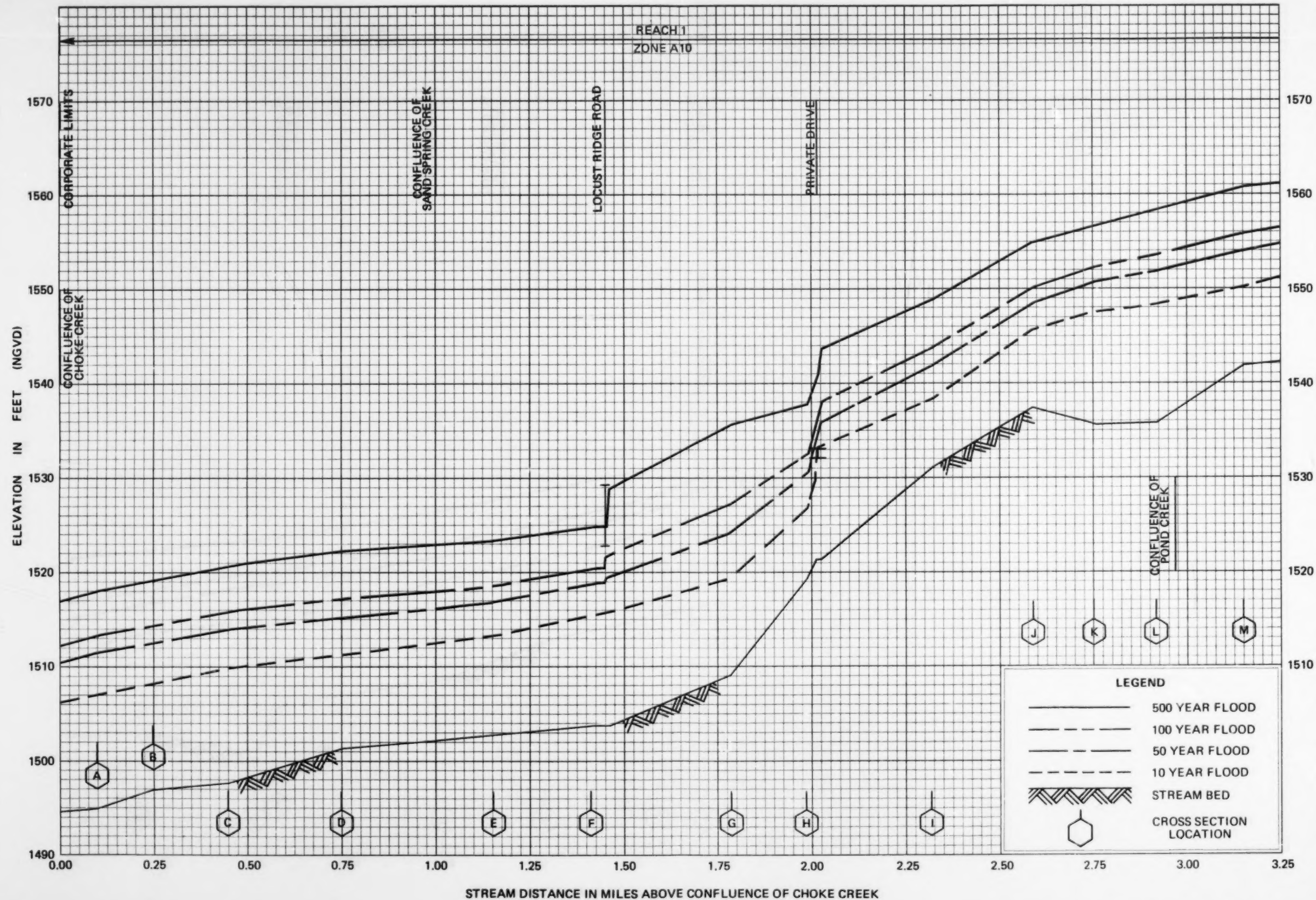
Commonwealth of Pennsylvania, Department of Environmental Resources, Stream Flow Records of Pennsylvania, Harrisburg, Pennsylvania, 1978.

U. S. Department of Commerce, Bureau of Public Roads, Hydraulics of Bridge Waterways, Washington, D. C., 1970.

U. S. Department of the Interior, Geological Survey, Water Resources Data for Pennsylvania, Part I, Surface Water Records, Harrisburg, Pennsylvania, Published Annually 1961-1978.

U. S. Department of the Interior, Geological Survey, Water-Supply Papers, Surface Water Supply of the United States, 1941-1978, Washington, D. C., 1978.





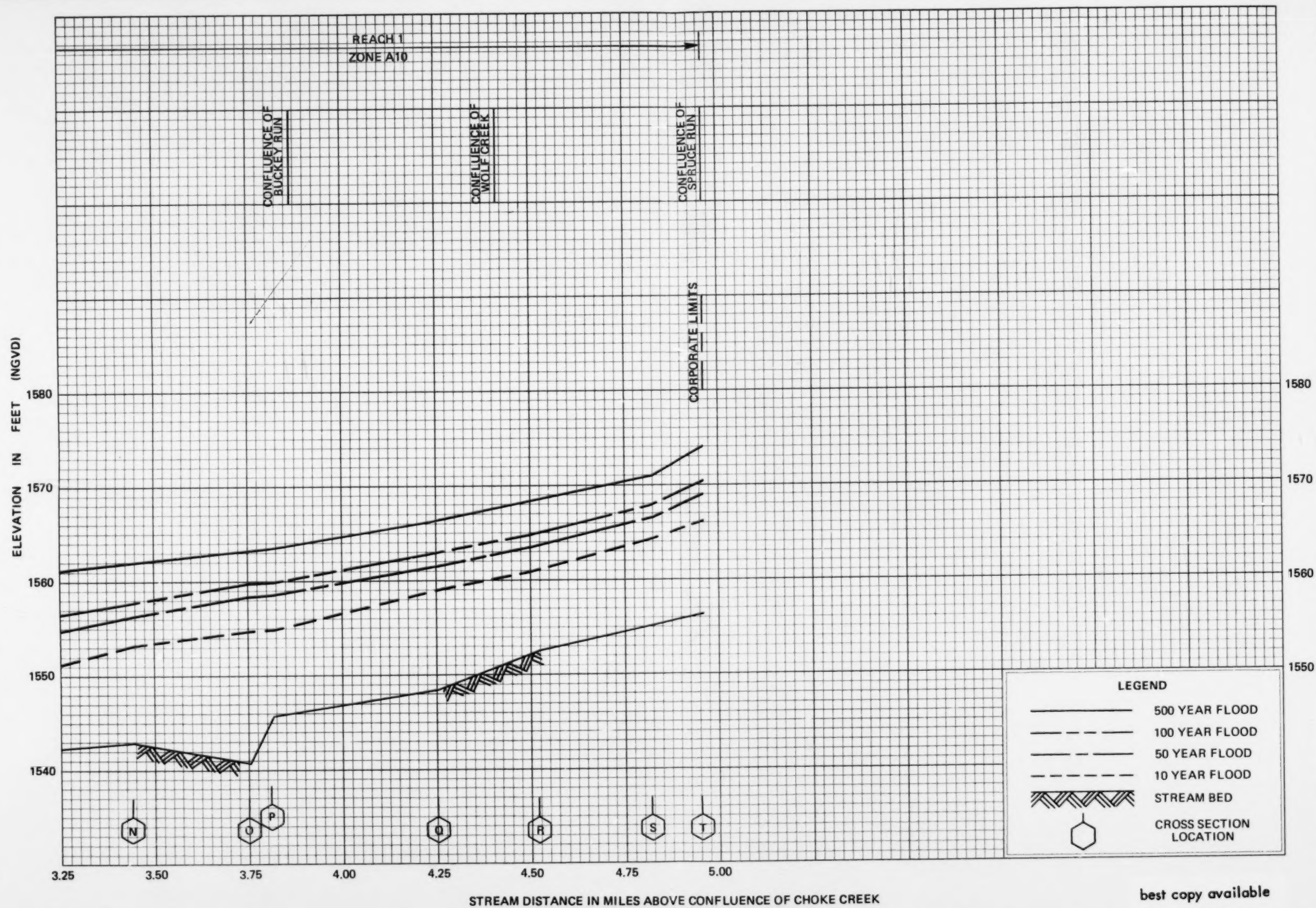
FLOOD PROFILES

LEHIGH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF LEHIGH, PA
(LACKAWANNA CO.)

01P



best copy available

FLOOD PROFILES

LEHIGH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF LEHIGH, PA
(LACKAWANNA CO.)

02P